CORRESPONDENCE

The Secretary,
The Institution of Civil Engineers.
DEAR SIR,

LONDON BASIN TERTIARY SEDIMENTS

I refer to the recent paper on the London Clay by Bishop, Webb, and Lewin (1965) and earlier papers by Skempton (1961) and Skempton and Henkel (1957). Bishop *et al.*, on the basis of laboratory assessment of pre-consolidation load, suggest that in the Ashford area some 1200 to 1300 ft of sediments have been removed by erosion. Skempton suggests some 500 ft have been removed from the Bradwell area 50 miles northeast of London, and Skempton and Henkel suggest some 500 ft to 700 ft for the Central London area. Assuming the validity of these figures, they pose a most interesting geological problem. The figures for Bradwell and Central London are in general agreement with thicknesses obtained by geological methods, but, as pointed out by Bishop *et al.*, the 1200 ft figure for west London is obviously in excess of the others and is not substantiated (or contradicted) by existing geological evidence.

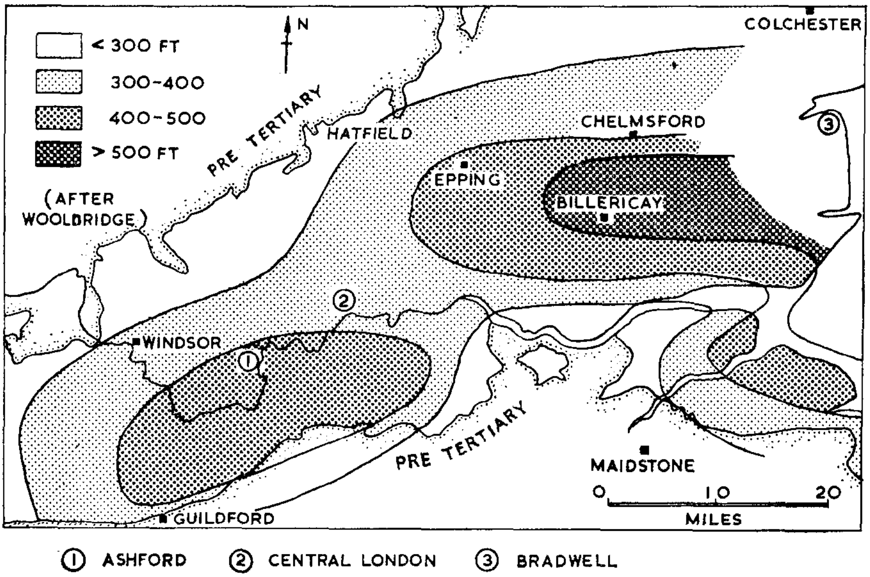

Fig. 1. Original thickness of the London Clay

Fig. 1 shows the maximum probable thickness of the London Clay in the London Basin before erosion; the figure is amended from one in a paper by Wooldridge (1926), which in addition contains a wealth of detail on the geology of the London Basin. As can be seen the clay was approximately 500 ft thick in Essex, and thinned to less than 300 ft westward and

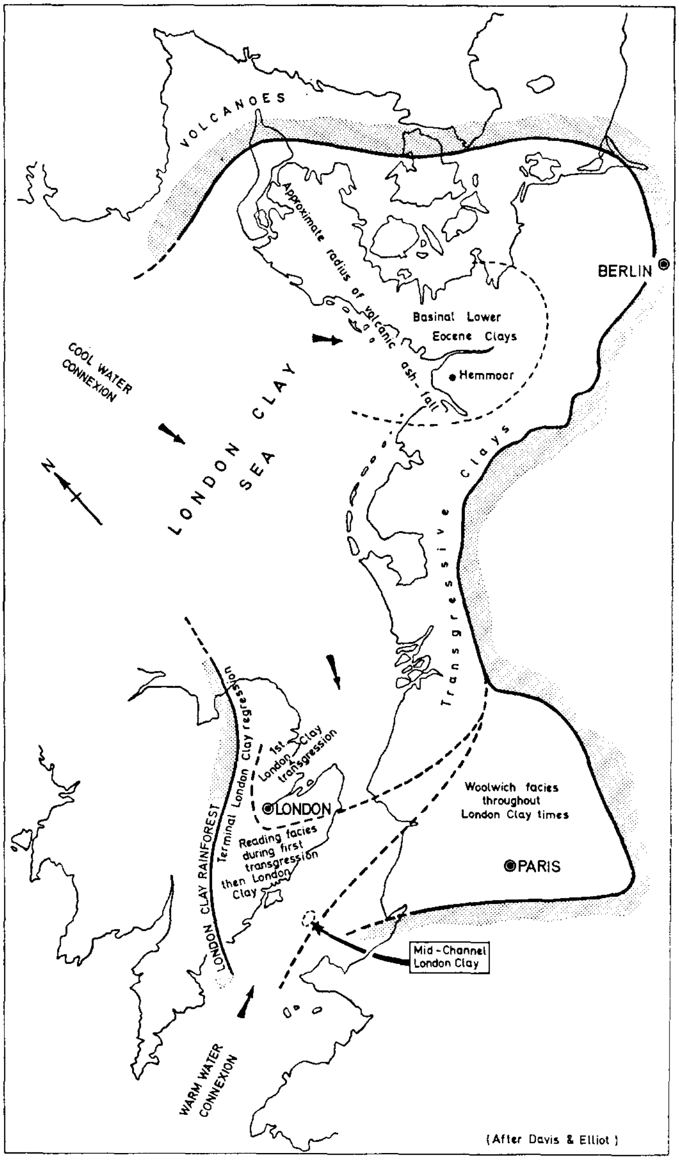

Fig. 2. The London Clay sea

towards the margins of the Basin. Fig. 2, given for interest, shows the reconstruction after Davis and Elliott (1957) of the paleogeography at the time of deposition of the London Clay in the London Clay Sea, some 50 million years ago. In general, this sea spread westwards from northwest Germany and finally into the Hampshire basin area during mid London Clay times where it connected to a warmer sea from the southwest with its associated famous tropical flora. The sea finally retreated southeastwards and ended London Clay times, some 40 million years ago. Following this in what is now southeast England, marine and sometimes deltaic or freshwater deposition continued throughout the Eocene to about the middle of the Oligocene (some 30 million years ago) and perhaps for a longer period of time in the Hampshire area.

This long period of deposition was followed by uplift and erosion. To the northwest of London and Hampshire was land that was never really submerged during the Tertiary or Quaternary, so no great thicknesses of waterlaid sediments are found. But in the last 5 million years or so, during the late Tertiary and Quaternary, marine deposition occurred in what is now East Anglia. The seas laying down these deposits, although at times they also extended over parts of southeast England, are recorded south of London principally by erosion surfaces as they never left anything more than a few feet of deposits.

The problem raised is how to explain the once greater thickness of now eroded sediments suggested for the Ashford area.

Table I summarizes the maximum known thickness of Tertiary deposits from the Hampshire and London Basins. They are quoted from the regional guides for the areas, and thicknesses have been rounded off to the nearest 10 ft.

It is clear that there is a greater thickness of sediments in the Hampshire Basin. Deposition either continued for a longer period in this area than in the London area or for a similar period but with more erosion subsequently in the London area. It is most likely, from geological evidence, that uplift took place after the beginning of Oligocene times in the London area, so there was no deposition and it was land undergoing erosion at the time the Hampshire Basin was receiving Oligocene sediments.

The table confirms the thicknesses suggested on laboratory evidence for the northeast and central areas of the London Basin. The Ashford thicknesses are more difficult to account for as they suggest some 500 ft of sediments in excess of what is currently thought to have existed. However, they could be explained by supposing the Barton Beds were once much thicker in the southwestern part of the London Basin (the upper portion of the Bartons is missing in any case in the London area, presumably by erosion). This bed is up to 370 ft thick in the Hampshire Basin. In addition, it could be speculated that some of the Oligocene sediments once extended from the Hampshire Basin into the southwest corner of the London Basin. The Oligocene sediments are preserved in some of the more strongly folded areas of the

Table 1

Maximum known thickness of Tertiary sedimentary deposits in the London and Hampshire Basins

	Tertiary Beds	Hampshire Basin		London Basin	
		Deposition conditions	Max. known thickness *ft*	Deposition conditions	Max. known thickness *ft*
		~~Erosion~~~			
Oligocene	Hamstead clays and sands	Freshwater-marine	260		
	Bembridge marls and limestones..	Freshwater-deltaic	120		
	Osborne clays	Brackish-freshwater	110		
	Headon clays and sands ..	Freshwater-marine	210		
				~~Erosion~~~	
Eocene	Barton clays and sands ..	Marine	370	Marine	50
	Bracklesham sands and clays	Marine	600	Marine	70
	Bagshot sands and clays ..	Deltaic	250	Marine (?)	120
	Claygate sands and clays ..	—	—	Marine	50
	London clays	Marine	400	Marine	430
	Totals		2 320		720

Hampshire Basin. Such folding does not occur in the London Basin so subsequent erosion may have removed all evidence of them.

Further geotechnical data from other London (and Hampshire) areas would be most helpful.

Yours faithfully,
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London.
16 March, 1966.

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The Secretary,
The Institution of Civil Engineers.

DEAR SIR,

THE STABILITY OF A SLURRY TRENCH IN COHESIONLESS SOILS

by N. Morgenstern and I. Amir-Tahmasseb (*Géotechnique* 15:4:387–395)

Bentonite slurry density readings were taken during the construction of the cofferdam cut-off wall at the Arrow Dam site, British Columbia, Canada.

The concrete diaphragm cut-off wall has been built in the cofferdam by Icanda Ltd., using their percussion hole and clamming technique. The wall is 2 ft 6 in. thick, has a surface area of 224 000 sq. ft and the maximum depth to bedrock is 170 ft. The cofferdam, approximately 80 ft high, was constructed by end dumping well-graded sands, gravels and cobbles. The river alluvium to bedrock consists of sands, gravels, cobbles, and boulders.

The calcium bentonite slurry had a density at the mixing plant of 1·03 to 1·04 grams/cu. cm. Slurry density readings were taken at different depths from ten excavated panels using a 'Frauteschy' sampling bottle. The in-situ slurry densities ranged from 1·07 to 1·16 grams/cu. cm being about constant with depth. The increase in slurry density from that at the mixing unit, was caused by suspended sand cuttings which ranged from 5% to 15% by weight of the slurry sample.

The length of the panels was approximately 24 ft and depths ranged from 90 to 145 ft. The river water level ranged from 8 to 15 ft below the fill level. No panels collapsed, although minor sloughing was observed in four of the panel walls in the upper 10–15 ft of the excavation.

Figure 1 is a plot of required slurry density versus the relative water level (m) computed from Morgenstern and Amir-Tahmasseb's equation 9, for values of $\phi = 35$, 40, and 45° and soil